1. An ultrasonic system for moving contaminants upwards within a processing tank, comprising: a processing tank for holding process liquid; an ultrasonic generator for generating ultrasonic drive signals through a range of frequencies as defined by an upper frequency and a lower frequency; at least one transducer connected to the tank and the generator, the transducer being responsive to the drive signals to impart ultrasonic energy to the liquid; and a controller subsystem for controlling the generator wherein the drive signals monitonically change from the upper frequency to the lower frequency to drive contaminants upwards through the liquid.

2. A system of claim 1, wherein the controller subsystem cyclically produces the drive signals such that the generator sweeps the drive signals from the upper frequency to the lower frequency over a first half cycle, and from the lower frequency to the higher frequency over a second one half cycle, the subsystem inhibiting the drive signals over the second half cycle to provide a quiet period to the liquid.

3. A system of claim 2, wherein the first and second one-half cycles have different time periods.

4. A system of claim 2, wherein each successive one-half cycle has a different time period such that a repetition rate of the first and second half cycles is non-constant.

5. A system of claim 2, wherein the first one-half cycle is a fixed period and wherein the second one-half cycle is non-constant.

6. A system of claim 2, wherein the first half cycle comprises a first time period, and wherein the second one half cycle comprises a second time period, the subsystem comprising means for varying the first or second time periods between adjacent cycles.

7. A system of claim 2, wherein the subsystem comprises means for shutting the generator off during the second one half cycle.

8. A system of claim 1, wherein the subsystem further comprises AM means for amplitude modulating the drive signals at an AM frequency.

9. A system of claim 8, wherein the AM means comprises means for sweeping the AM frequency.

10. A system of claim 8, wherein the AM means comprises means for sweeping the AM frequency from a high frequency to a low frequency and without sweeping the AM frequency from the low frequency to the high frequency.

11. A system of claim 8, wherein the subsystem comprises means for inserting a quiet or degas period before each monotonic AM frequency sweep.

12. An ultrasonic system for moving contaminants upwards within a processing tank, comprising: a processing tank for holding process liquid, an ultrasonic generator for generating ultrasonic drive signals through a range of frequencies defined between an upper frequency and a lower frequency, at least one transducer connected to the tank and the generator, the transducer being responsive to the drive signals to impart ultrasonic energy to the liquid, and a controller subsystem for controlling the generator through one or more cycles, each cycle including monotonically sweeping the drive signals from the upper frequency to the lower frequency, during a sweep period, and recycling the generator from the lower frequency to the upper frequency, during a recovery period, the sweep period being at least nine times longer than the recovery period.

13. A system of claim 12, wherein the controller subsystem comprises means for varying a time period for each cycle wherein the time period is non-constant.

14. An ultrasonic system for moving contaminants upwards within a processing tank, comprising: a processing tank for holding process liquid; an ultrasonic generator for generating ultrasonic drive signals; at least one transducer connected to the tank and the generator, the transducer being responsive to the drive signals to impart ultrasonic energy to the liquid; and a amplitude modulation subsystem for amplitude modulating the drive signals through a range of AM frequencies characterized by an upper frequency and a lower frequency, the subsystem monotonically changing the AM frequency from the upper frequency to the lower frequency to drive contaminants upwards through the liquid.

15. A system of claim 14, wherein the generator comprises means for sweeping the drive signals from upper to lower frequencies to provide additional upwards motion of contaminants within the liquid.

16. A system of claim 14, wherein the subsystem comprises AM frequencies between about 1.2khz and a lower frequency of 1Hz.

17. A system of claim 14, wherein the AM frequencies are between about 800Hz and a lower frequency of 200Hz.

18. A system of claim 16 or 17, further comprising means for varying a time period between the upper frequency and the lower frequency.

19. A multi-generator system for producing ultrasound at selected different frequencies within a processing tank of the type including one or more transducers, comprising:

a generator section having a first generator circuit for producing first ultrasonic drive signals over a first range of frequencies and a second generator circuit for producing second ultrasonic drive signals over a second range of frequencies, the generator section having an output unit connecting the drive signals to the transducers, each generator circuit having a first relay initiated by a user-selected command wherein either the first or the second drive signals are connected to the output unit selectively.

20. A system of claim 19, further comprising a 24VDC supply to provide power for relay coils.

21. A system of claim 19, each generator circuit further comprising a second relay for energizing the circuit, and further comprising two time delay circuits, the first time delay circuit delaying generator circuit operation over a first delay period from when the second relay is energized, the second time delay circuit delaying discontinuence of the first relay over a second delay period after the generator circuit is commanded to stop, the first delay period being longer than the second delay period such that no two generators circuits operate simultaneously and such that all generator circuits are inactive during switching of the first relay.

22. A system of claim 21, further comprising one of a PLC, computer, or selector switch for selecting an operating generator circuit by way of supplying a reference voltage to the two relays of the operating generator circuit.

23. A system of claim 22, wherein each relay coil operates at a common reference voltage.

24. A probe system for sensing process conditions within an ultrasonic process tank of the type that includes process liquid, the liquid being subjected to ultrasound produced by transducers coupled to a generator, comprising:

(a) an enclosure for housing a sample liquid, the enclosure passing ultrasonic energy from the process liquid to the sample liquid, the sample liquid being responsive to the energy; and

(b) one or more sensing transducers within the sample liquid, the transducers generating signals indicative of characteristics of the sample liquid.

25. A probe system of claim 24, wherein the housing comprises polypopylene.

26. A probe system of claim 24, wherein one transducer comprises means for determining the conductivity of the sample liquid and for generating a signal indicative of the conductivity.

27. A probe system of claim 24, wherein one transducer comprises means for determining the temperature of the sample liquid and for generating a signal indicative of the temperature.

28. A probe system of claim 24, further comprising a temperature transducer attached to the outside of the housing for determining a temperature of the process liquid and for generating a signal indicative of the temperature.

29. A probe system of claim 24, further comprising an analysis subsystem for collecting the signals and for evaluating the signals over time.

30. A probe system of claim 29, wherein the subsystem comprises means for generating control signals which control the generator in response to evaluated signals over time.

31. A probe system of claim 29, wherein the subsystem comprises a microprocessor.

32. A probe system of claim 29, further comprising means for determining total cavitation energy released based upon signals indicative of temperature of the sample liquid over time.

33. A probe system of claim 29, further comprising means for calculating total energy released from cavitation through the following relationship: energy (calories) = specific heat x mass of the sample liquid x change in temperature (°C).

34. A probe system of claim 29, further comprising means for determining cavitation density based upon signals indicative of conductivity of the sample liquid.

35. A probe system of claim 34, further comprising means for determining cavitation density as a function of time.

36. A probe system of claim 29, wherein the subsystem comprises memory for storing at least one of the following parameters: specific heat (p) of the sample liquid, volume (V) of the sample liquid, mass (m) of the sample liquid, and a functional relationship defined as $n=f(C,C_o)$ between conductivity and a number (n) of cavitation implosions.

37. A probe system of claim 36, further comprising means for calculating cavitation density based upon $n/V=f(C,C_o)/V$.

38. A probe system of claim 36, further comprising means for calculating energy in each cavitation implosion based upon $(0.00833)(p)(m)(g(t'))/V/\ f(C,C_0)/t'$, where t' corresponds to a time of measurement.

39. A probe system of claim 36, further comprising means for calculating cavitation density based upon cavitation density as a function of time = $f(h(t))/V$.

40. A probe system of claim 36, further comprising means connected to the generator for controlling the generator based upon calculations of the subsystem.

41. A probe system of claim 40, further comprising one or more comparators for comparing the calculations to one or more stored parameters.

42. A probe system of claim 29, wherein the subsystem comprises feedback means for controlling generator frequency in response to the signals.

43. A probe system of claim 29, wherein the subsystem comprises feedback means for controlling generator power output in response to the signals.

44. A probe system of claim 29, wherein the subsystem comprises feedback means for amplitude modulating signals from the generator to control cavitation density as a function of time within the process liquid.

45. A variable voltage ultrasonic generator system, comprising:

an ultrasonic generator;
a switching regulator for regulating a 300 VDC signal to +12V and +15V lines, the generator being connected to the +12V and +15V lines; and
a power factor correction circuit connected to AC power, the power factor correction circuit providing 300 VDC output to the generator and to the regulator, the generator thus being automatically operable from world voltage sources between 86 VAC and 264 VAC.

46. A variable voltage ultrasonic generator system, comprising:

an ultrasonic generator; and
a universal switching regulator, connected to AC power, for regulating a set of DC voltages to the generator, the generator thus being automatically operable from world voltage sources between 86 VAC and 264 VAC.

47. A variable voltage ultrasonic generator system, comprising:

an ultrasonic generator;
a constant peak amplitude triac circuit connected to AC power, the triac circuit converting the AC power to a 121.6 voltage peak, or less, AC signal;
a bridge rectifier and filter connected to the peak AC signal for rectifying and filtering the AC signal and for generating a DC voltage less than (86)($\sqrt{2}$) volts; and
a switching regulator for regulating the DC voltage to 12 VDC and 15 VDC, the generator being connected to the DC voltage, the 12 VDC and the 15 VDC, the generator thus being automatically operable from world voltage sources between 86 VAC and 264 VAC.

48. A laminar process tank for holding process liquid, comprising: a tank housing having at least one wall, a floor and at least one over-flow weir; a recirculating inlet within the floor for forcing new liquid to the tank; a first baffle constructed and arranged within the tank and adjacent the inlet for reducing velocity of the new liquid introduced to the tank; and a second baffle constructed and arranged above the floor, the second baffle forming a plurality of holes wherein the new liquid first passes through the holes prior to migration upwards through the process liquid.

49. A quick dump rinse tank, comprising: a tank housing having at least one wall and a floor; a valve within the floor for dumping liquid within the tank, selectively; a vacuum reservoir connected pressurewise to the valve; and a pump, connected to the reservoir for reducing pressure within the reservoir to below atmospheric pressure.

50. An ultrasonic generating unit, comprising:

a printed circuit board having an ultrasonic generator for generating ultrasonic drive signals; and

a plurality of ultrasonic transducers responsive to the drive signals to generate ultrasound, the printed circuit board having an aperture for each transducer, each transducer being mounted within an aperture wherein the printed circuit board and transducers define a single structural unit.

51. An AC power system, comprising:

a capacitive element, the capacitive element being characterized by a predetermined capacitance C, the capacitive element having a first terminal and a second terminal, the second terminal being coupled to earth ground;

an inductive element, the inductive element being characterized by a predetermined inductance L and having a first terminal and a second terminal;

a direct electrical connection between the second terminal of the inductive element and the first terminal of the capacitive element, whereby the inductive element is electrically resonant with the capacitive element substantially at a resonant frequency $f_r = 1/T_r$;

a first drive network coupled by a transformer between a reference potential +V and the first terminal of the inductive element, the transformer having first and second primary windings and a secondary winding;

a second drive network coupled by a transformer between the reference potential +V and the first terminal of the inductive element;

wherein the first drive network includes a first multistate switch network and a first blocking network in series between circuit ground and the first primary winding, the first drive network providing a unidirectional current flow path characterized by a first impedance from the potential +V through the first primary winding when the first switch network is in a first state, and providing an oppositely directed and unidirectional current flow characterized by a second impedance through the first primary winding to the potential +V when the first switch network is in a second state, wherein the first impedance is lower than the second impedance;

wherein the second drive network includes a second switch network and a second blocking network in series between circuit ground and the second primary winding, the second drive network providing a unidirectional current flow path characterized by a third impedance from the potential +V through the second primary winding when the second switch network is in a first state, and providing an oppositely directed and unidirectional current flow characterized by a fourth impedance through the second primary winding to the potential +V when the second switch network is in a second state, wherein the third impedance is lower than the fourth impedance;

further comprising control means for cyclically switching the first network between its first and second states at a frequency $f = 1/T$, where f is lower than $f_r$, whereby the first switch network is in its first state for a period greater than or equal to $T_r/2$, but less than or

equal to T/2, at the beginning of each cycle and is in its second state for the remainder of each cycle, and

cyclically switching the second network between its first and second states at the frequency f, whereby the second switch network is in its first state for a period greater than or equal to $T_r/2$, but less than or equal to T/2, at the beginning of each cycle and is in its second state for the remainder of each cycle, wherein the start time for each cycle of the second switch network is offset by at least $T_r/2$ and less than or equal to $T_r/2 + D$ from the start time for each cycle of the first switch network, where D is substantially equal to $T-T_r$,

whereby an AC voltage at frequency f is impressed across the capacitive element.

52. An AC power system of claim 51, wherein the inductance L is incorporated into the transformer as leakage inductance.

53. An ultrasonic transducer, comprising a backplate, front driver, at least one piezoceramic disposed between the backplate and front driver, and a bias bolt connected between the front driver and backplate to provide compressive force on the piezoceramic, the piezoceramic being responsive to applied ultrasonic energy wherein the transducer resonates through a range of frequencies within a bandwidth, the backplate being shaped non-linearly so as to modify the ultrasonic power corresponding to each frequency within the bandwidth.

54. An ultrasonic transducer of claim 53, wherein the backplate comprises steel material having a cut-away section that changes the overall acoustic resonance of the transducer, over frequency.

55. An ultrasonic transducer of claim 53, wherein the backplate comprises steel material having a curved section that changes the overall acoustic resonance of the transducer, over frequency.

56. An ultrasonic transducer of claim 53, wherein the backplate comprises steel material having a non-linear sloped section that changes the overall acoustic resonance of the transducer, over frequency.

57. An ultrasonic transducer of claim 53, wherein the backplate is shaped such that ultrasonic power for any frequency within the bandwidth is within about a two factor of ultrasonic power for any other frequency within the bandwidth, wherein the transducer generates substantially equal power when operating at all frequencies within the bandwidth.

58. An ultrasonic transducer of claim 53, wherein the transducer is connected to a system having non-linear power throughput as a function of frequency, and wherein the backplate is shaped such that ultrasonic power generated through the system for any frequency within the bandwidth is within about a two factor of ultrasonic power for any other frequency within the bandwidth, wherein the transducer non-linearly generates power through the frequencies within the bandwidth so as to compensate for the non-linear power throughput of the system.

59. An ultrasonic transducer of claim 53, wherein the front driver comprises material selected from the group of aluminum and steel.

60. An ultrasonic transducer of claim 53, wherein the bolt has a bolt head and wherein the front driver comprises a form fit aperture-sink to the bolt head, further comprising a nut screwed onto the bolt adjacent to the backplate, the aperture-sink preventing counter-rotation of the bolt while screwing the nut onto the bolt.

61. An ultrasonic transducer of claim 53, wherein the front driver has a diameter and wherein the bolt comprises a bolt head that spans approximately the diameter, the bolt extending through the transducer with the bolt head adjacent to the front driver, wherein the transducer is mountable to an object through an interface with the bolt head and without interface with the front driver.

62. An ultrasonic transducer of claim 61, wherein the bolt head is shaped so as to vary power output as a function of frequency over the range.

63. An ultrasonic transducer of claim 53, wherein the front driver and backplate form a cavity for the piezoceramic, further comprising (a) electrical connections to the piezoceramic and (b) an 0-ring disposed between the front drive and the backplate so as to seal the piezoceramic and the connections within the cavity and against adverse environmental conditions.

64 An ultrasonic processing system, comprising an ultrasonic tank and a plurality of transducers connected to the tank, each of the transducers having a diameter X and being responsive to applied energy to generate ultrasound within the tank, the transducers being spaced and arranged at distances of about 2X between any two adjacent transducers.

65. A system of claim 64, further comprising a G- 10 isolator bonded between the tank and at least one of the transducers.

66. A system of claim 64, further comprising epoxy to bond the G-10 isolator to the transducer and the tank.

67. An ultrasonic transducer for producing ultrasound within a process tank, comprising at least one piezoceramic compressed between a backplate and the tank, a bias bolt connects between the backplate and the tank to provide compression, the piezoceramic and backplate having a length L that defines fundamental frequencies of the transducer.

68. A transducer according to claim 67, further comprising a weld on the tank, the bias bolt being connected to the tank through the weld.

69. A double compression transducer for producing ultrasound within an ultrasound tank, comprising:

a front plate and backplate;

at least one piezoceramic sandwiched between the front plate and backplate;

a bias bolt having an elongated bias bolt body between a bias bolt head and a threaded portion, the bias bolt body extending through the front plate and the piezoceramic and being connected with the backplate, the bias bolt forming a through-hole interior that axially extends between the head and the threaded portion;

a second bolt having an elongated body between a second bolt head and a threaded tip, the body being disposed within the bias bolt, the second bolt head being rigidly attached to the tank; and

a nut for screwing onto the threaded tip and adjacent to the backplate;

wherein the bias bolt provides a first level of compression of the piezoceramic, and wherein the second bolt provides a second level of compression of the front plate and the tank.

70. A transducer of claim 69, wherein the threaded portion screws into the backplate.

71. A transducer of claim 69, further comprising a bias bolt nut for screwing onto the bias bolt adjacent to the backplate.

72. A transducer according to claim 69, further comprising a Belleville disc coupled to the second bolt and arranged between the tail mass and the nut to provide spring tension to the second level of compression.

73. A transducer according to claim 69, further comprising epoxy bonded between the front driver and the tank, to provide additional ultrasonic coupling to the tank.

74. An ultrasonic transducer, comprising a backplate, front driver, at least one piezoceramic sandwiched between the backplate and front driver, and a bias bolt connected between the front driver and backplate to provide compressive force on the piezoceramic, the piezoceramic being responsive to applied ultrasonic energy wherein the transducer resonates through a range of frequencies within a bandwidth, the front driver forming an axial cavity to accommodate the bias bolt, the cavity extending away from the piezoceramic at a proximal end, adjacent the piezoceramic, and a distal end, the front driver forming a threaded portion at the distal end to mate with the bias bolt.

75. A transducer according to claim 74, wherein the threaded portion comprises a helical insert.

76. A transducer according to claim 74, wherein the insert comprises steel.

77. An acid resistant transducer, comprising a non-metallic backplate, a non-metallic front driver, epoxy disposed between the front driver and backplate, and at least one piezoceramic disposed within the epoxy, the epoxy providing compressive force on the piezoceramic, the piezoceramic being responsive to applied ultrasonic drive signals wherein the transducer resonates through a range of frequencies within a bandwidth.

78. A transducer according to claim 77, further comprising Teflon wiring connected to the piezoceramic and through the epoxy to transmit the drive signals to the piezoceramic.

79. A transducer according to claim 77, wherein the front driver comprises quartz.

80. A transducer according to claim 77, wherein the backplate comprises quartz.

81. An internally switchable ultrasonic generator system, comprising one or more ultrasonic transducers responsive to a first frequency and a harmonic frequency of the first frequency, an ultrasonic generator circuit for producing drive signals at the first frequency and the harmonic frequency, selectively, and a constant power output circuit for adjusting the power output from the generator such that ultrasonic power eminating from the transducers remains constant between the first frequency and the harmonic frequency.

82. A generator system of claim 81, further comprising means for switching between the first and harmonic frequencies without imparting intermediate drive signals to the transducers.